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(54) Modular Large-area Display Panel

(57) A large area multi-element matrix display panel, e.g. liquid crystal or electroluminescent, composed of flat modules, for alphanumeric or image display, consists of glass plates with a grid of conductive, transparent electrodes and with electronic selection for each picture element. Such a panel consists of only three types of module, namely a type (1) comprising the X—Y conductor tracks, transparent image electrodes and the electronics directly associated with the picture elements in the form of thin film switching elements, type (2) modules comprising the peripheral selection electronics for the columns as integrated circuits, and type (3) of module comprising the selection electronics for the rows as thin film circuits. The three types are mounted flat and adjacent on a base plate, connected by multiple contact strips at contacting edges.

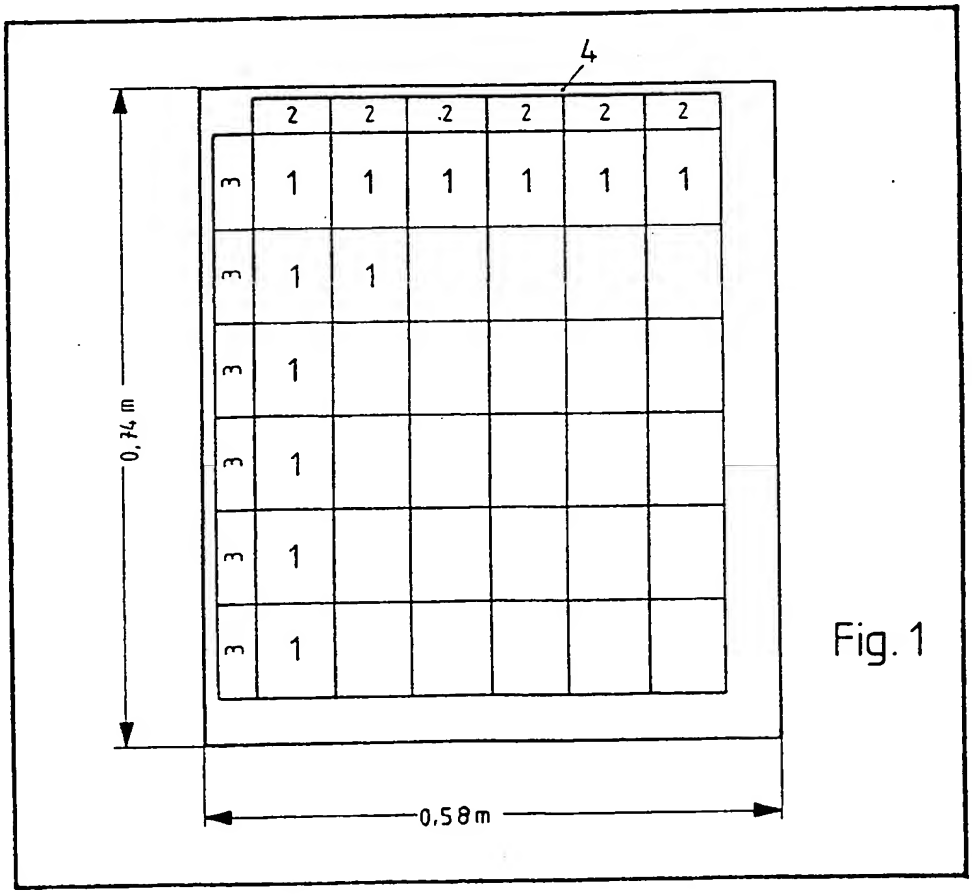

Fig. 1

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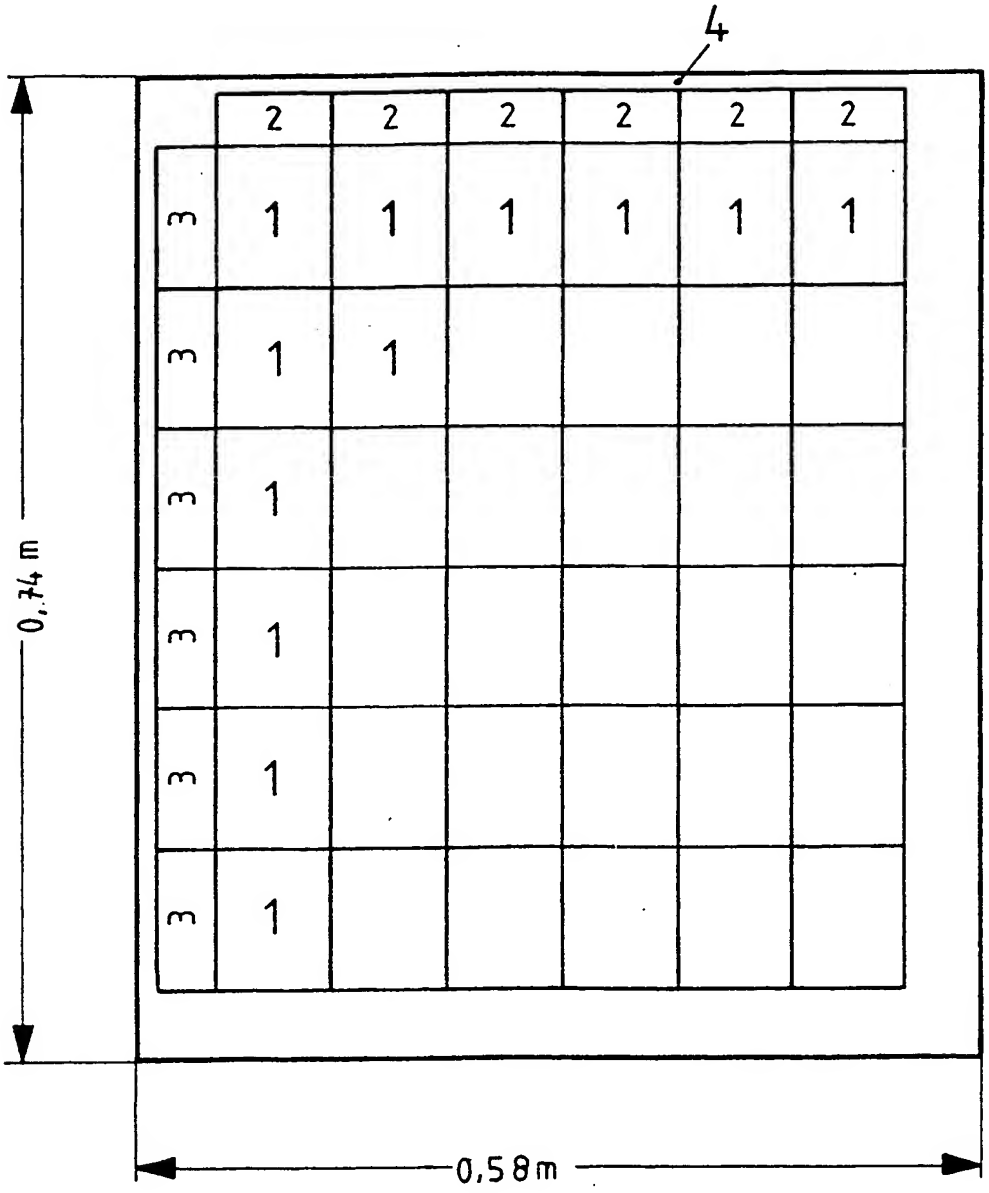

Fig. 1

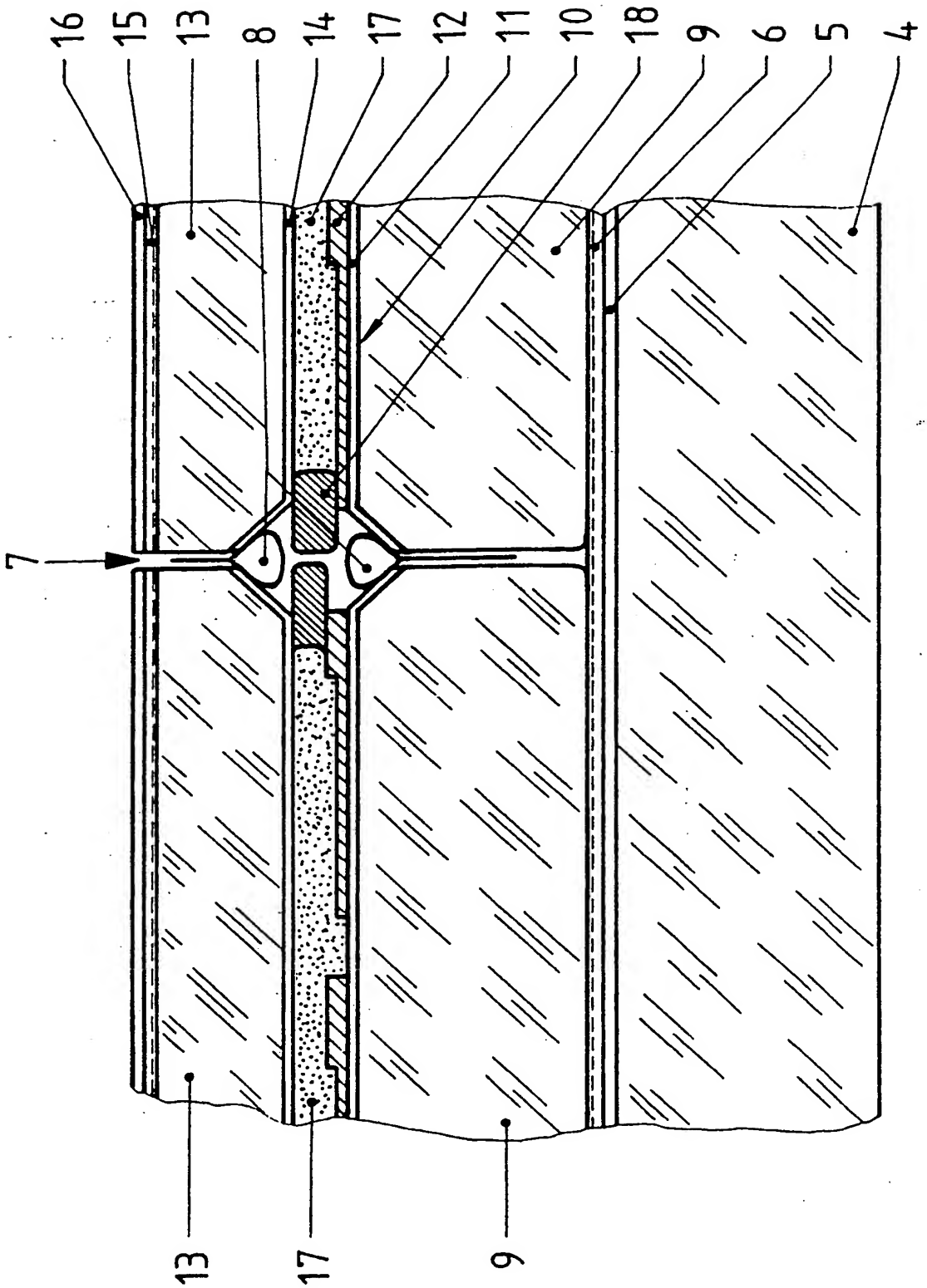

Fig. 2

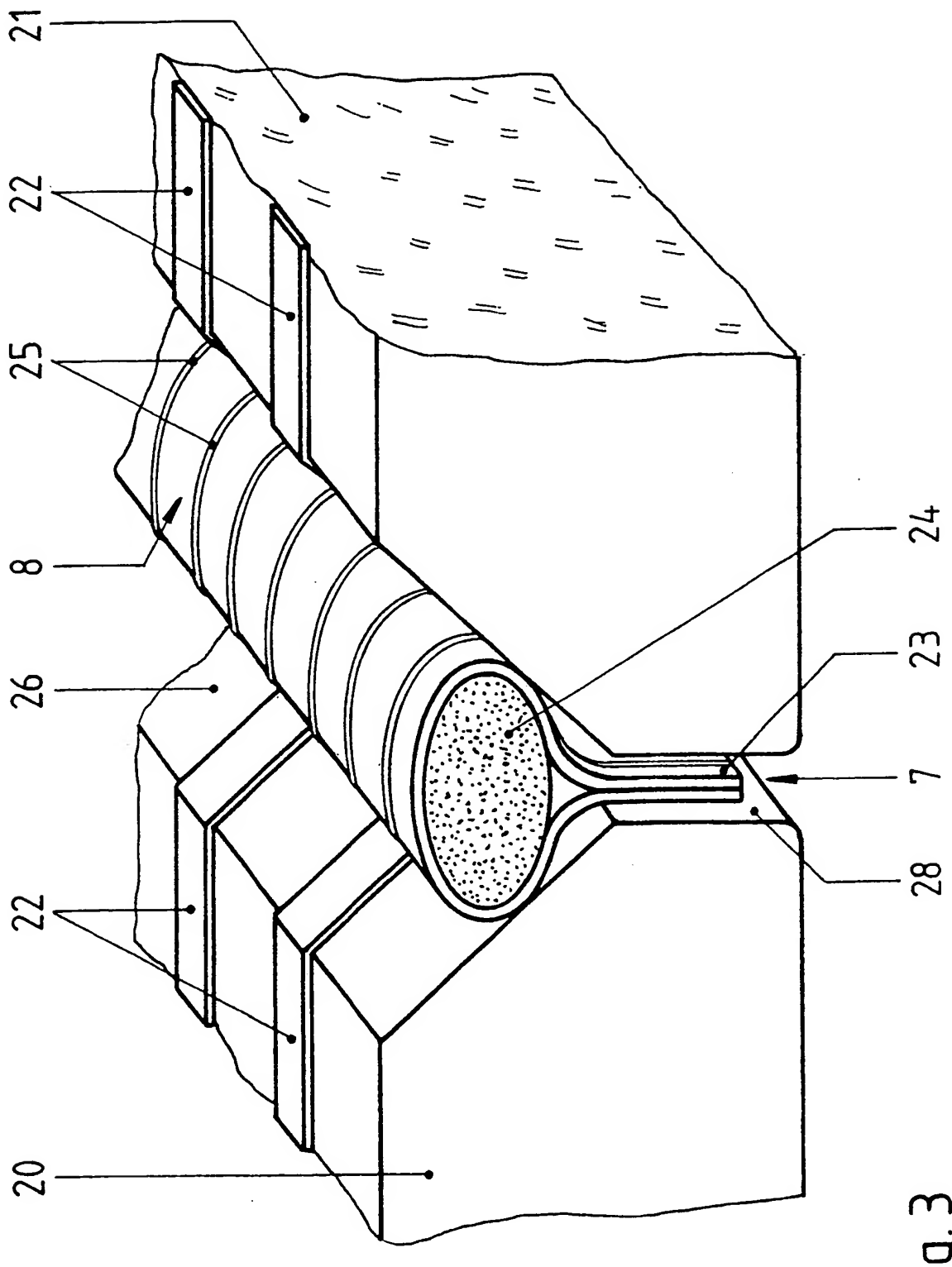

Fig. 3

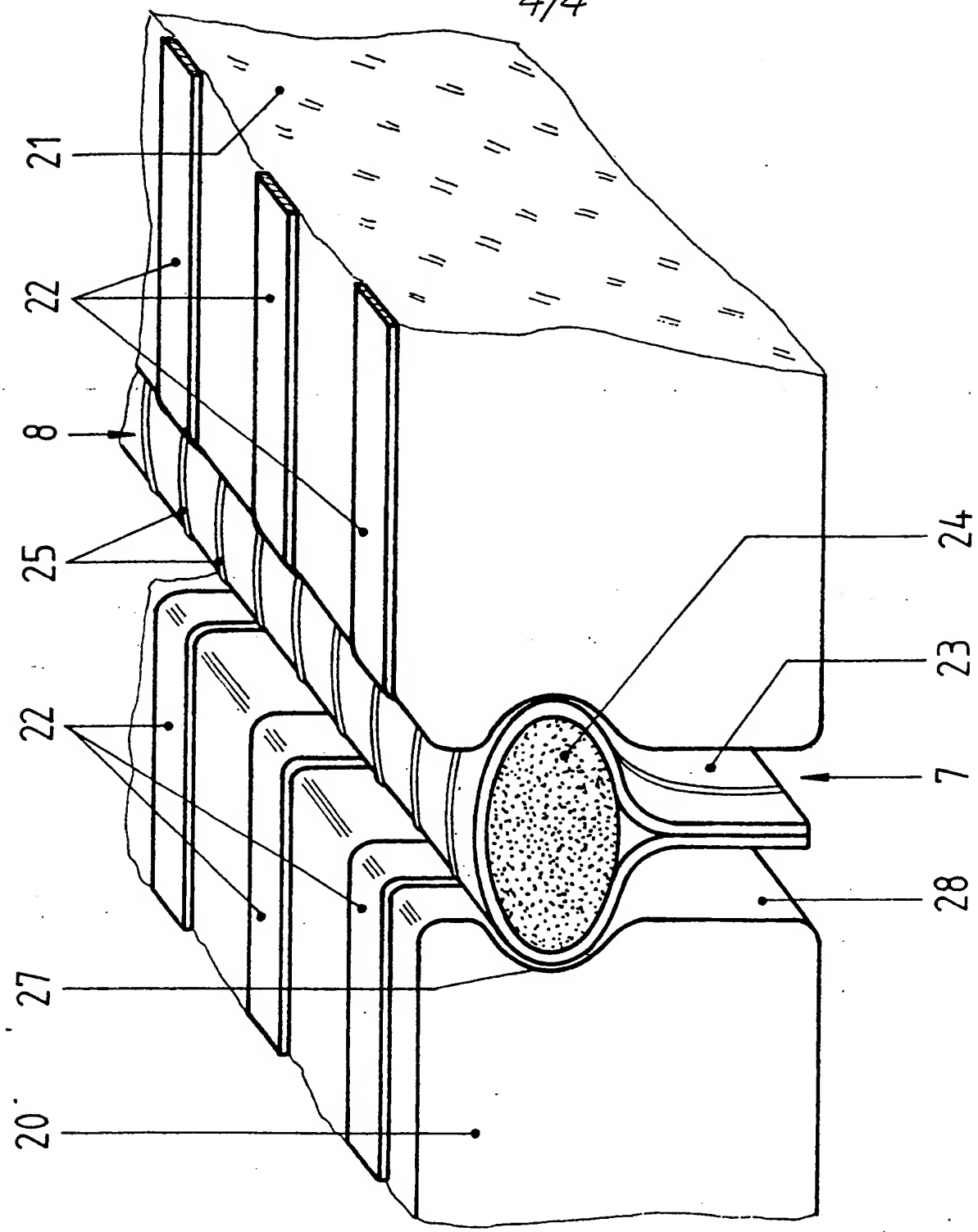

Fig.4

SPECIFICATION

Large-Area Multi-Element Information Display Panel Composed of Flat Modules

The invention relates to a large-area multi-element information display panel in matrix configuration and composed of flat modules, for alphanumeric or image reproduction purposes, consisting of glass plates which are provided with a grid of conductive, transparent electrodes and with an electronic selection system for each matrixed picture element.

Multi-element matrix information display panels are known, for example, from the journal "Microelectronics", Vol. 7 No. 4, 1979, pages 5 to 15. These are either display panels in which the picture elements consist of electrically excited electroluminescent particles, or display panels in which the picture elements consist of liquid crystal cells which are switched by electric fields. Both types have the common feature that, in order to excite each individual picture element, a matrix of transparent electrodes and a thin film circuit consisting of transistors and a capacitor, associated with each picture element, are required. In order to select the conductor tracks, peripheral electronics are required which temporarily store the picture information to be displayed and at the appropriate moment pass this information on the column and row lines.

The conductor tracks and the thin film transistor matrix are produced by vapour deposition on glass plates in a vacuum. However, it is not possible to produce evaporation masks to any desired size and maintain the necessary accuracy, and it is also not possible to find absolutely plane glass plates of any desired size for liquid crystal display screens. With the present state of the art, therefore, the size of a flat television screen would be limited to dimensions of approximately 18×24 cm^2.

In order to eliminate this disadvantage, it is already known to assemble several small-area display panels without contacts into a large-area display screen. In this arrangement, each glass plate carries not only the x—y conductor tracks and the thin film transistor matrix but on its back side also the selection electronics for the column and the row lines. The picture information to be displayed by the individual module is fed to its peripheral electronic selection circuitry via separate rear lines from a central memory and processor constructed from silicon integrated circuits. It is clear that such a solution makes the display screen more complicated and expensive due to the expensive central megabit memory. In addition, such a design solution is possible only with those display panels which do not have to have light passed through them from behind—as is done for example with display panels working with liquid crystals—that is to say only with opaque luminous displays.

It is the basic object of the present invention to specify a large-area information display panels which is composed of small, flat, transparent modules with back illumination, for example for a flat liquid crystal television screen, the individual modules of which can be mass-produced relatively simply and cheaply and which does not require an expensive central memory and processor.

This object is achieved by a display panel consisting of only three types of modules, namely a first type of module which comprises the X—Y conductor tracks, the transparent image electrodes and the electronics directly associated with the picture elements in the form of thin film switching elements, a second type of module which comprises the peripheral selection electronics for the column lines in the form of integrated circuits, and a third type of module which comprises the selection electronics for the row lines in the form of thin film circuits which are mounted flat and adjacent to one another on a base plate and are connected to one another by multiple contact strips which produce the electric connection between edges of the modules bordering on one another.

This results in the advantage, also for transparent display screens with back illumination, that modules with great accuracy can be used which are small and thus can be produced economically, that these modules can be replaced in the case of defects, and that the interconnections between the modules are practically invisible.

In preference, the multiple-contact strips are elastic and fixed adhesively to the edges of the modules in such a manner that two strips are fixed adhesively to each module. Such multiple-contact strips are commercially available in the US; their construction is apparent from the attached drawings.

In order to use the multiple-contact strips to produce the electric connection between the conductor tracks of adjacent modules a bevel can preferably be provided at the upper edges of the glass plate which is provided with the conductor tracks and extensions of the conductor tracks can be vapour-deposited onto this bevel which can be done in the same vapour deposition process with which the conductor tracks are produced.

As an alternative to this, diamond tools can be used to machine a concave channel into the end faces of the glass plate which is provided with the conductor tracks and the conductor tracks can be extended into this concave channel in an additional operation. In this embodiment the joint between two modules is narrower, although its production is somewhat more expensive than that of the one mentioned first.

These modules are preferably adhesively fixed to a transparent base plate. Further advantages and developments of the invention can be found in the following description of illustrative embodiments with the aid of the drawing, in which:

Figure 1 shows a diagrammatic representation of a top view of a large-area, flat display screen,

Figure 2 shows a detail in cross-section of a

flat display screen according to the invention in the region of two adjoining modules,

Figure 3 shows a first possibility of electrically connecting two modules, and

Figure 4 shows a second possibility of electrically connection two modules.

As shown in Figure 1, a flat display screen consists of only three types of modules. This is firstly the picture module 1 the size of which is, for example, 90×120 mm², with, for example, 100 rows and 100 columns, corresponding to 10,000 picture elements. There is provision for thirtysix modules 1. In addition, there is a further module 3 containing fast shift registers, row memories and row stitches. Its size is, for example, 40×120 mm². Each module contains 100 stages of the shift register, of the memory and of the row switch. The shift register has, for example with the television screen, a dwell time per stage of 10^{-7} Sec. Six modules are required. There is also the module 2 with a slow shift register. The size of this module is, for example, 20×90 mm². Each module comprises 100 stages of the slow shift register. This shift register has a dwell time per stage of 60 μsec. Six modules are provided. All three types of modules 2 (sic) are attached to a plane base plate 4, for example of float glass. In the example shown, this base plate has a size of 74×58 cm.

Figure 2 shows the construction of the flat display screen composed of individual modules. The base plate 4 can be seen. This base plate has an adhesive layer 5 applied to it which is used to attach the individual modules. This adhesive layer consists either of a thermoplastic or a cold-setting transparent plastic material. On top of the adhesive layer a first polariser 6 is located since the example shown represents a display panel working with liquid crystals of the twisted nematic type. In addition, a separating gap 7 can be seen between two modules which are provided with electric contacts with the aid of elastic multiple-contact strips 8. Each module consists of a lower glass plate 9 which carries on its top surface transparent matrix conductor tracks 10 and transparent electrodes 11 for the thin film transistors 12. In addition, each module contains an upper glass plate 13 the bottom surface of which carries a transparent conductive layer 14 and the top surface of which carries a second polarisation film 15 and a light diffuser 16. In the gap between the two glass plates 9, 13 there is also the liquid crystal material 17 which is prevented from escaping by seals 18. In order to improve the contrast, white light can be radiated through the display screen from the base plate 4 so that the picture elements become visible as light, grey or dark points.

Figure 3 shows how the conductor tracks of two adjoining modules are connected with the aid of elastic multiple-contact strips. A first glass plate 20 can be seen and a second glass plate 21 which carry on their upper surface the conductor tracks 22. The two glass plates 20, 21 are provided at their top edges with a bevel 26 and the conductor tracks 22 are drawn over the bevel. Between the two glass plates the multiple-contact strip 8 is located which consists of a strip of plastic film 23 to the outside of which fine metal strips 25, for example of gold, are applied. The plastic strip 23 is wound over an elastic cylindrical foam cylinder 24 and welded together on one side. The flat side of the multiple contact strip 8 is adhesively fixed to the end face 28 of the glass plates 20, 21 which is not provided with conductor tracks. In this arrangement, the conductor tracks 25 form the electric connection between the conductor tracks 22 of the adjoining modules.

Figure 4 shows a variant in which a concave channel 27 is milled with diamond tools into the end faces of the glass plates 20, 21. The conductor tracks 22 are extended at the end faces into the concave channel 27. In this case the gap 7 between the modules is narrower than in the embodiment of Figure 3 but production of the concave channel is somewhat more expensive.

It is understood that not only the commercially available multiple-contact strips with the elastic foam cylinder, shown in the drawings, can be used but also those without foam cylinder. If flat foil strips are used, the edge bevels or concave channels can even be omitted.

Claims

1. A large-area multi-element information display panel in matrix configuration and composed of flat modules, for alphanumeric or image reproduction purposes, consisting of glass plates which are provided with a grid of conductive, transparent electrodes and with an electronic selection system for each matrixed picture element, characterised by a display panel consisting of only three types of modules, namely a first type of module, which comprises the X—Y conductor tracks, the transparent image electrodes and the electronics directly associated with the picture elements in the form of thin film switching elements (12), a second type of module (2.1, 2.2) which comprises the peripheral selection electronics for the column lines (10, 22) in the form of integrated circuits, and a third type of module (3.1, 3.2) which comprises the selection electronics for the row lines (10, 12) in the form of thin film circuits which are mounted flat and adjacent to one another on a base plate (4) and are connected to one another by multiple contact strips (8) which produce the electric connection between edges of the modules (1, 2, 3) bordering on one another.

2. An information display panel according to Claim 1, characterised by elastic multiple-contact strips (8) adhesively fixed to the end faces (28) of the modules (1, 2, 3).

3. An information display panel according to Claim 1 or 2, characterised by a bevel (26) at the upper edges of the glass plates (20, 21) which are provided with the conductor tracks (22), and that the conductor tracks (22) are extended past this bevel (26).

4. An information display panel according to Claim 1 or 2, characterised by a concave channel (27) in the end faces (28) of the glass plates (20, 21) which are provided with the conductor tracks (22), and in that the conductor tracks (22) are extended into this concave channel (27).

5. An information display panel according to at least one of Claims 1 to 4, characterised in that the modules (1, 2, 3) are adhesively attached to the baseplate (4).

6. An information display panel substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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